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Title: **Environmental Management Policy Analysis – using – Complex System Simulation**

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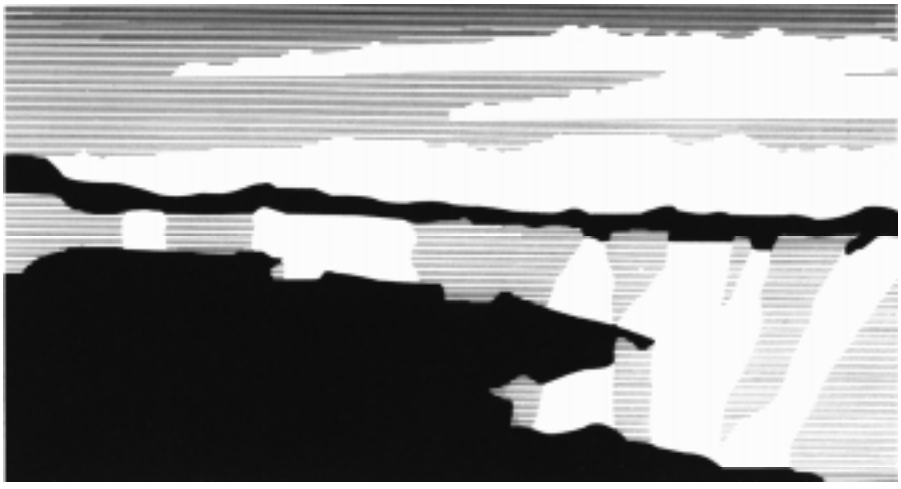

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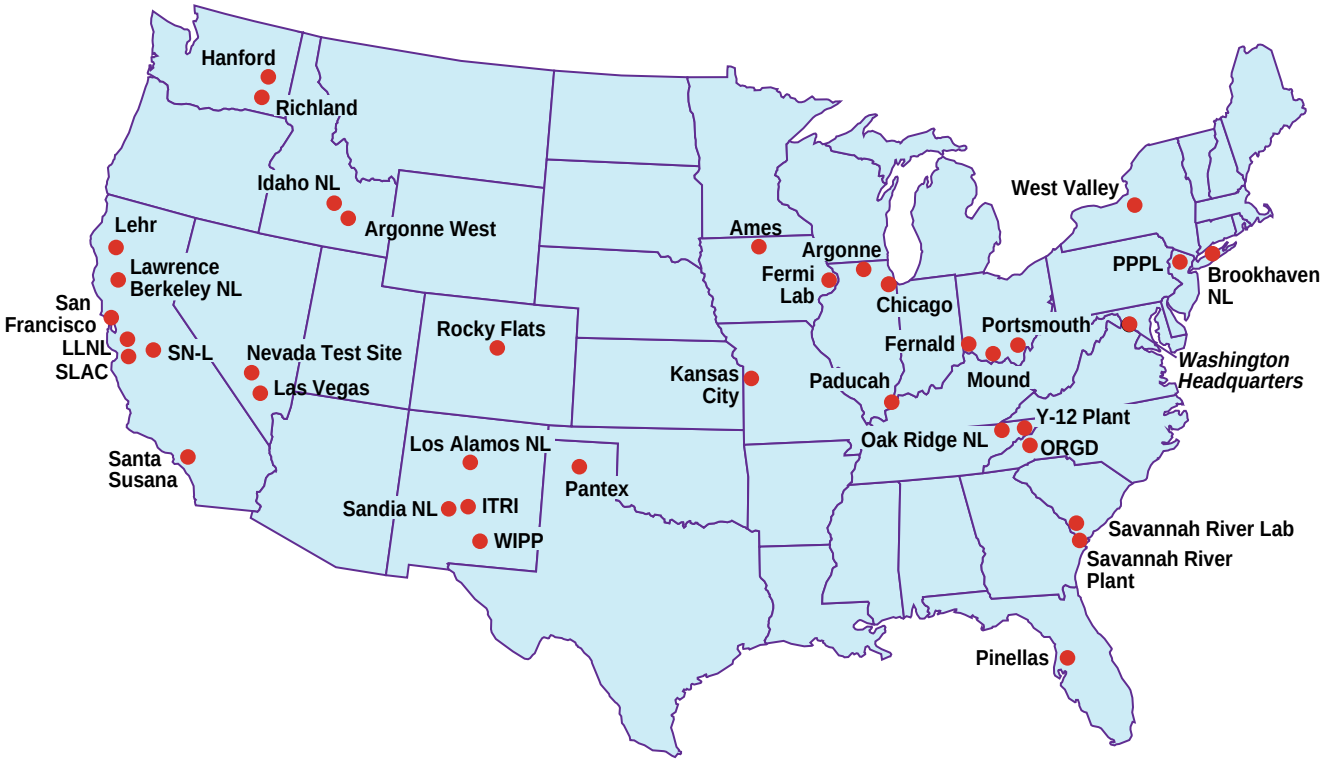
ENVIRONMENTAL MANAGEMENT POLICY ANALYSIS

- USING -

COMPLEX SYSTEM SIMULATION

3 Feb 1998



Rob Oakes

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Wayne Hardie

Environmental Management Policy Analysis Using Complex System Simulation

BACKGROUND

- TSA . . Envir C/B, flow modeling, safety risk assessments
- Envir Mgmt needs complete system
- exs . . TRANSIMS, FDE, JWARS

OBJECTIVE

- Using simulation science techniques for analyzing complex systems, assist DOE/EM policy makers by developing and applying an environmental technology evaluation tool

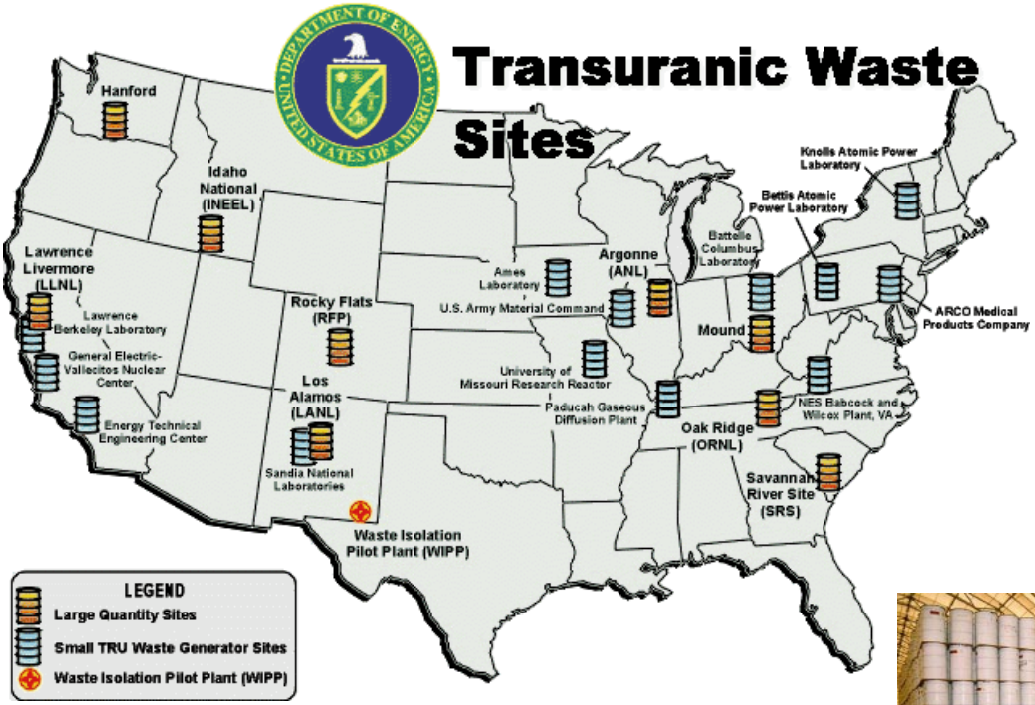
FY 97

- model proposed Los Alamos pit production, including waste
- model storage and transport of TRU waste from Los Alamos to WIPP

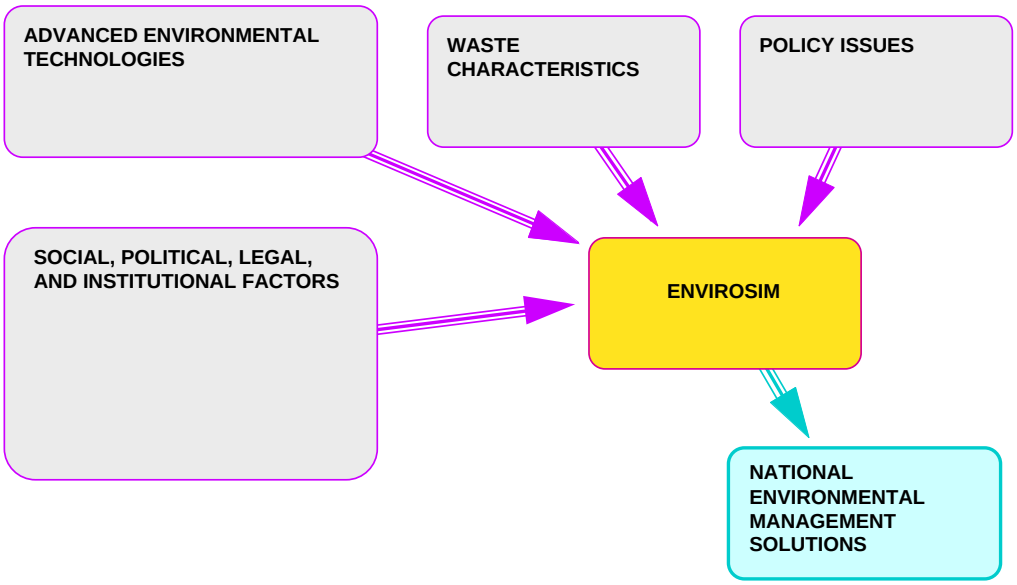
FY 98

- expand transportion model to include DOE complex
- add costing to models
- investigate generative analysis

We view this work as being very supportive of the potential TRU waste focus area, as well as the ModSim effort currently being pursued by Los Alamos.



THE ENVIROSIM APPROACH



FEATURES

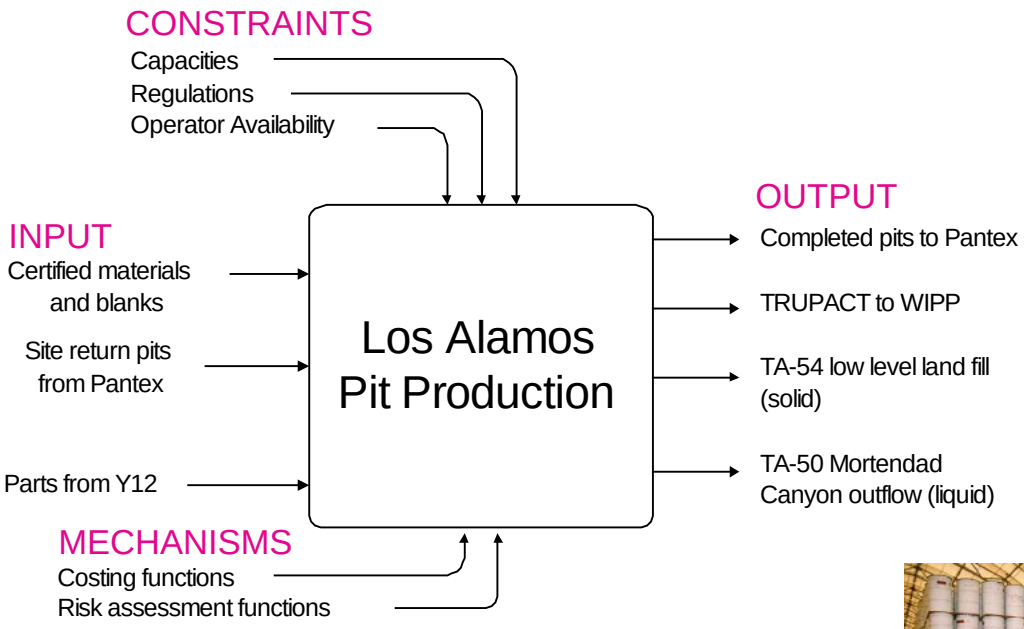
- **Complex System**
  Collection of interacting components (actors or agents)
- **Emergent Behavior**
  Emergent macro properties result from interactions among the components and their environment
- **Reductionist Approach**
  Break system into smaller and smaller parts and analyze properties of parts → **Holistic Approach**
  Analyze global properties by incorporating interactions of various components
- **Comparative Analysis**
  Introduce changes to baseline simulation and investigate impact of changes to system → **Generative Analysis**
  Search the systems phase space to find configuration that best meets objectives

DOE'S INTEGRATED PRIORITY LIST

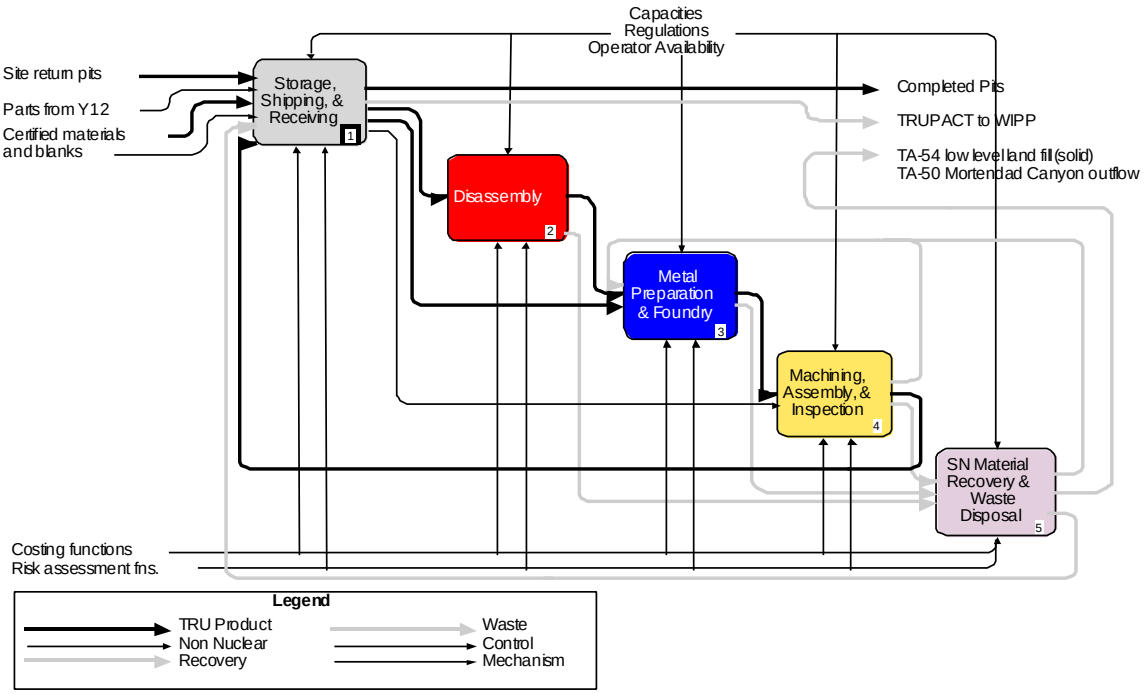
- Eliminate the most urgent risks
- Maintain compliance
- Reduce mortgage and support costs
- Protect worker health and safety
- Reduce the generation of waste
- Create a collaborative relationship
- Focus science and technology development
- Integrate waste treatment and disposal across sites

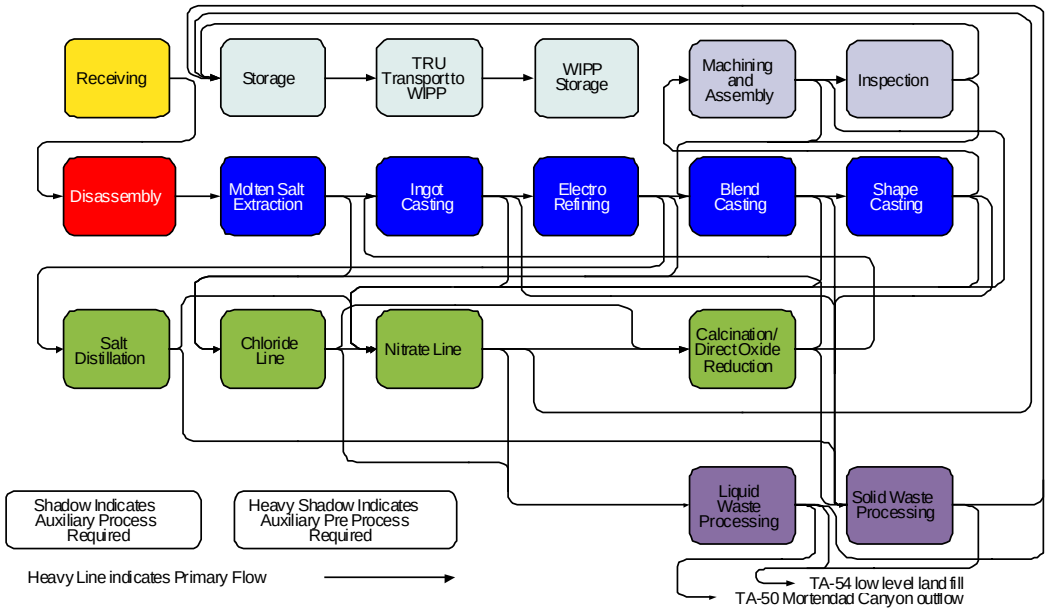
**U.S. DOE 2006 Plan, October 20, 1997, Update Version 5.0*

Model of Proposed Los Alamos Pit Production

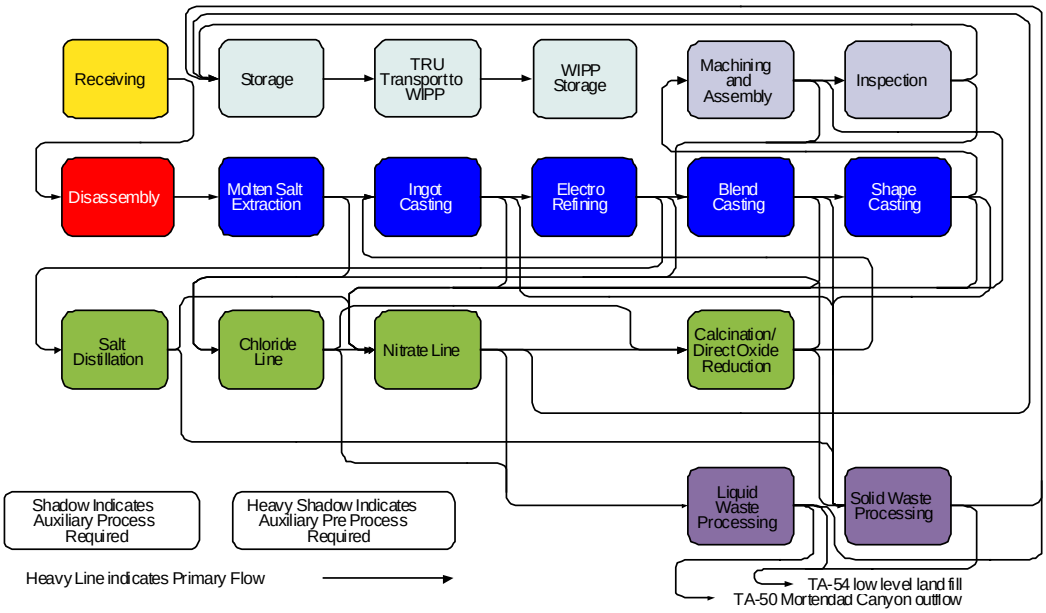


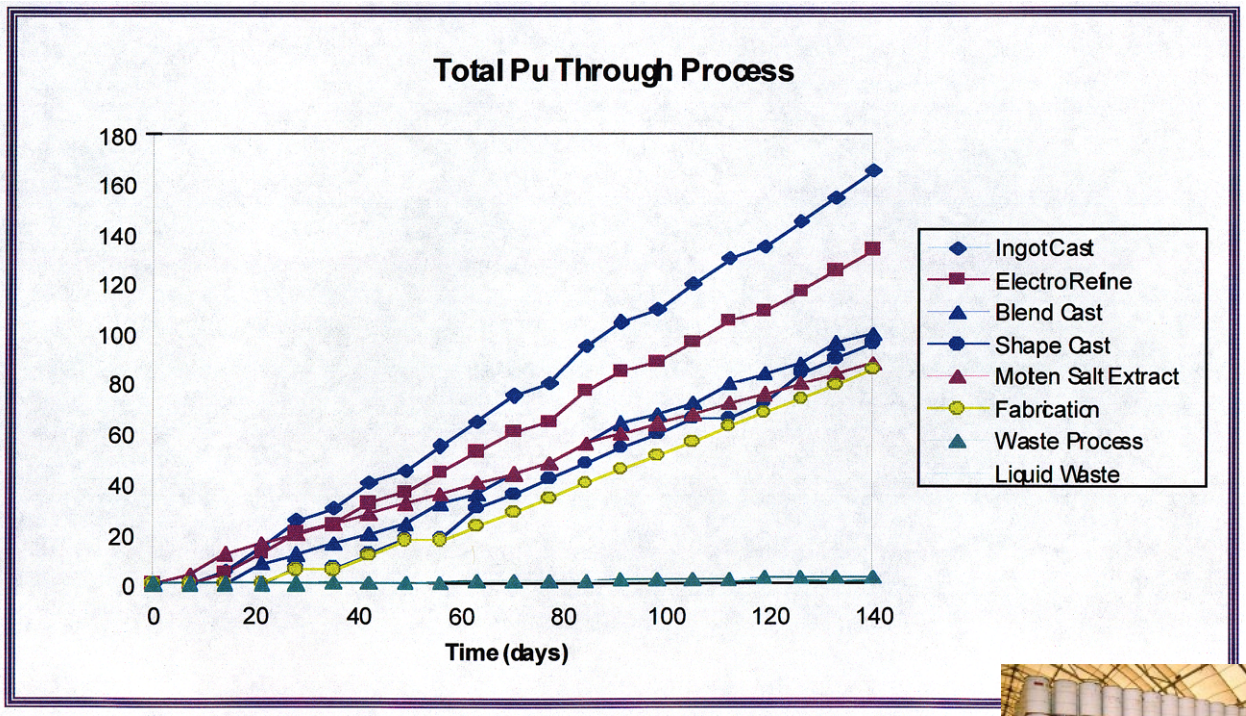
Model of Proposed Los Alamos Pit Production



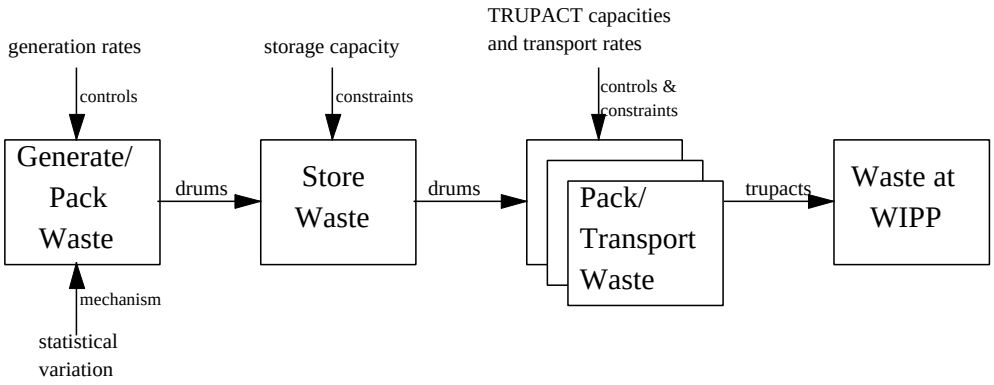


Some Results of Proposed Los Alamos Pit Production Simulation





LANL WIPP TRU Waste Transport Model



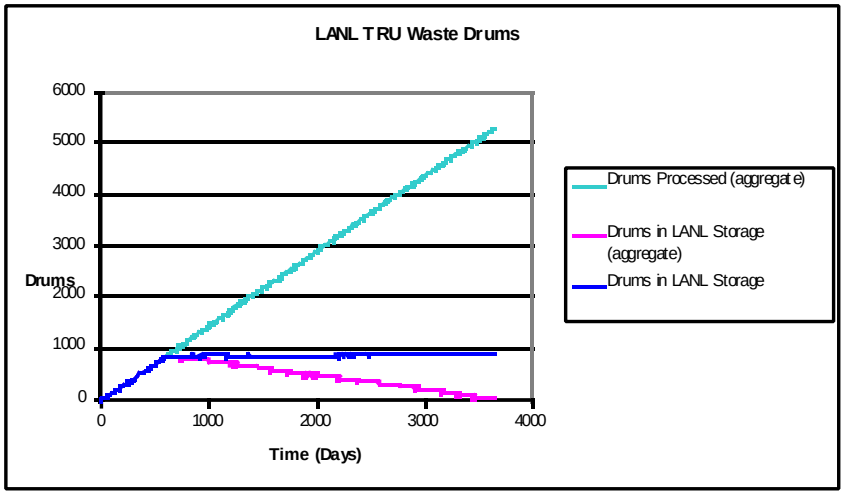
- Dates of Simulation - Ten Years
  - begin: June, 1996
  - complete: May, 2006
  - begin WIPP shipment: January 1998

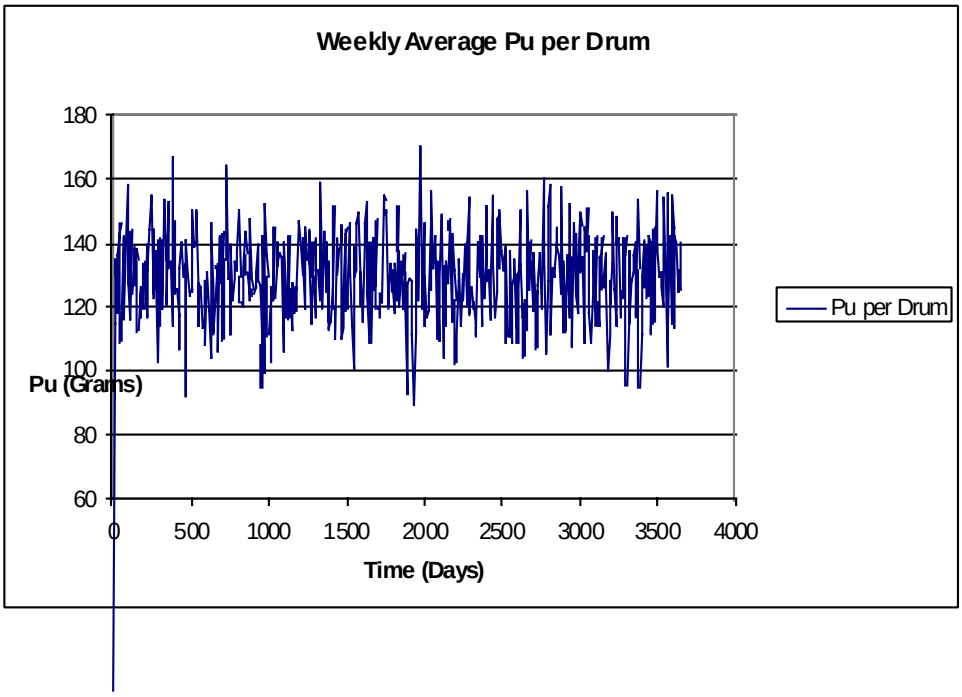
- Waste Packing (into drums)
  - between 9 grams and 200 grams Pu per drum
  - 180 grams Pu per drum most likely

- LANL TRU Waste Generation and Storage Information
  - between 6 drums and 15 drums per week
  - 10 drums per week most likely
  - 1000 drums maximum stored at LANL

- TRUPACT and Transportation Information
  - 3 TRUPACTS available for LANL to WIPP transport
  - 325 grams Pu max per TRUPACT
  - 14 drums max per TRUPACT
  - 4 day cycle, load, transport, unload, return

Some Results of the Waste Transport Model





NEXT STEPS

- expand transportion model to include DOE complex
- add costing to models
- investigate generative analysis

the DOE Complex

TRU Waste Storage Locations and Volumes (in cubic meters)

Site	Location	CH-TRU Waste Stored*	CH-TRU Waste Projected	RH-TRU Waste Stored*	RH-TRU Waste Projected
Argonne National Laboratory-East (ANL-E)	Argonne, IL	83	12	0	0
Hanford Reservation (Hanford)	Richland, WA	16,407	9,251	200	2,420
Idaho National Engineering Laboratory (INEL)	Idaho Falls, ID	65,102	81	86	53
Lawrence Livermore National Laboratory (LLNL)	Livermore, CA	249	905	0	0
Los Alamos National Laboratory (LANL)	Los Alamos, NM	7,770	9,259	94	136
Mound Plant (Mound)	Miamisburg, OH	239	12	0	0
Nevada Test Site (NTS)	Nevada	623	12	0	0
Oak Ridge National Laboratory (ORNL)	Oak Ridge, TN	1,303	256	962	193
Rocky Flats Environmental Technology Site (RFETS)	Golden, CO	1,043	14,741	0	0
Savannah River Site (SRS)	Aiken, SC	9,165	3,773	0	0
Small Quantity Sites					
Ames Laboratory (Ames)	Ames, IA	0	<1	0	0
ARCO Medical Products Company (ARCO)	West Chester, PA	<1	0	0	0
Babcock & Wilcox - NES (B&W Lynchburg)	Lynchburg, VA	18	0	0	0
Battelle Columbus Laboratories (Battelle)	Columbus, OH	0	0	581	0
Bettis Atomic Power Laboratory (BAPL)	West Mifflin, PA	0	123	0	2
Energy Technology Engineering Center (ETEC)	Santa Susana, CA	2	0	6	1
General Electric-Vallecitos Nuclear Center (GE-VNC)	Pleasanton, CA	5	4	5	8
Knolls Atomic Power Laboratory (KAPL)	Niskayuna, NY	0	0	6	<1
Lawrence Berkeley Laboratory (LBL)	Berkeley, CA	<1	1	0	0
Paducah Gaseous Diffusion Plant (PGDP)	Paducah, KY	2	0	0	0
Pantex Plant (Pantex)	Amarillo, TX	<1	0	0	0
Sandia National Laboratories (SNL)	Albuquerque, NM	7	6	1	2
Teledyne Brown Engineering (Teledyne Brown)	Westwood, NJ	<1	0	0	0
U.S. Army Material Command (USAMC)	Rock Island, IL	3	0	0	0
University of Missouri Research Reactor (MURR)	Columbia, MO	<1	<1	0	0
Total Waste Volumes		102,025	38,437	1,941	2,816

* volumes prior to treatment and repackaging

Information from the National TRU Waste Management Plan, DOE/NTP-96-1204, Revision 0, September 30, 1996

WIPP user priority: Idaho, LANL, Rocky

COSTS

- ave WIPP cost of disposal = $15-17k/drum
- ave cost pkging/insp at sites = $6-9k/drum
- variable cost may be $10k/drum

THE BOTTOM LINE

- want to support and collaborate with TRU waste focus area
  - costs
  - quantities
  - schedule
- want to utilize a form of envirosim for case study under ModSim